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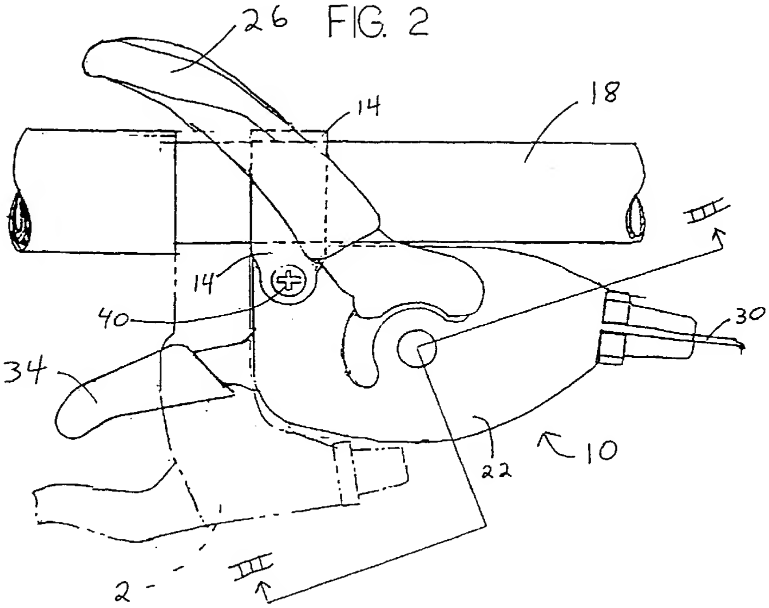
(54) A bicycle transmission shifting apparatus

(57) An apparatus for operating a bicycle transmission shifting device having an operating component (10) for mounting to a bicycle in close proximity to a brake operating unit for alternately pulling and releasing a transmission element, a first lever (26) is mounted to the operating component (10) for movement which causes the operating component (10) to pull the transmission element and second lever (34) is mounted to the operating component (10) for movement which causes the operating component (10) to release the transmission element. The first lever (26) and the second lever (34) are mounted to the operating component (10) so that the brake operating unit is disposed between the first lever (26) and the second lever (34) when the shifting device is mounted to the bicycle. In order to be able to construct the shifting device with only a single pawl (98) for the release mechanism the takeup element for the transmission element includes a control member (72) having a plurality of large and small position retaining teeth (80a-80c) and (82a-82f) for engaging the single release pawl (98).

FIG. 2



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Description

BACKGROUND OF THE INVENTION

A. Field Of The Invention

The present invention is directed to a front gear derailleur shifting mechanism for bicycles and, more particularly, to a shifting mechanism which includes indexing for accurate derailleur movement with respect to sprockets of a corresponding sprocket set.

B. Description of the Related Art

Bicycles, for instance racing bicycles and mountain bicycles, often include both front and rear chain derailleur mechanisms having corresponding handlebar mounted shifting mechanisms. The shifting mechanism effects positional changes of the chain derailleur mechanism by controlling movement of a cable connected therebetween. Recently, such shifting mechanisms have included indexing devices which cause the positional changes to be accurately controlled to put the chain derailleur into generally consistent predetermined positions with respect to chain sprockets in a corresponding sprocket set.

Most rear chain derailleur mechanisms, shifting mechanisms and the corresponding chain sprockets are designed, sold and installed on a bicycle as a matched set where the indexing device in the shifting mechanism is configured to selectively position the chain derailleur in approximate alignment with each chain sprocket of the corresponding sprocket set. However, front chain derailleurs are often not installed on a bicycle as a set with a corresponding set of chain sprockets, but rather the front gear derailleur and shifting mechanism may be used with a sprocket set whose sprockets that have dimensions different from those the shifting mechanism's indexing was designed to function with. Consequently, the indexing of the shifting mechanism may cause the chain derailleur to move to a position that is not in acceptable alignment with one of the sprockets of the sprocket set, thus causing the chain to scrape the derailleur, or worse, may not allow the chain to properly engage the one of the sprockets in the sprocket set.

A known indexed shifting apparatus for bicycles is disclosed in U.S. Patent No. 5,203,213. As shown in Figs. 3 and 4 of that patent, this type of shifting device includes a support shaft (11) fixed to a bracket (B) mounted on a handlebar; a takeup reel (2) rotatably mounted on the support shaft (11) for alternately pulling and releasing a control cable (I) a first control lever (4) pivotable about the support shaft (11) for causing the takeup reel (2) to pull the control cable (I); and a second control lever (7) for causing the takeup reel (2) release the control cable (I). The first control lever (4) engages feed teeth (21) on takeup reel (2) through a feed pawl (41) to cause the takeup reel (2) to rotate in the cable pulling direction. The second control lever (7) engages two sets of position retaining teeth (31,61) takeup reel (2) through two pawls (32,62) to cause the takeup reel to rotate in the cable release direction. The first control lever (4) and the second control lever (7) are both mounted at a position below the handlebar for operation by the index finger and thumb of a cyclist's hand.

The above described bicycle shifting mechanism is configured for shifting between five or more chain sprockets in a sprocket set and is typically used with the rear derailleur of a bicycle. However, with minor modification, for instance, fewer position retaining teeth, the shifting apparatus may be used with a front gear derailleur. Front gear derailleurs are typically used with a sprocket set having only two or three sprockets, thus necessitating reducing the number of position retaining teeth in the shifting mechanism. However, there remains the problem of accurately positioning the derailleur with sprockets in a sprocket set whose positioning requirements differ from the configuration of the indexing of the shifting mechanism.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided an apparatus for shifting positions of a bicycle derailleur in accordance with Claim 1. According to a second aspect of the present invention, there is provided a bicycle transmission shifting apparatus in accordance with Claim 3.

Preferred embodiments provide a shifting mechanism that may be used with multiple types of sprockets sets, each sprocket set having dimensions differing from other sprocket sets.

In a preferred embodiment of the present invention, a shifting mechanism is configured for selectively moving a chain derailleur between a plurality of positions corresponding to positions of sprockets of a plurality of differing sprocket sets. The shifting mechanism includes a control member mounted for selective rotational movement within the shifting mechanism structure. The control member is formed with a plurality of large position retaining teeth and a plurality of small position retaining teeth, at least one of the small position retaining teeth formed between each adjacent one of the large position retaining teeth. Each of the large position retaining teeth is positioned on the control member to

correspond to the positions of the sprockets in a first of the plurality of differing sprocket sets, and at least one of the small position retaining teeth corresponds to the position of one sprocket in a second of the plurality of the differing sprocket sets.

These and other objects, features, aspects and advantages of the present invention will become more fully apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings where like reference numerals denote corresponding parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side elevational view of a bicycle having a handlebar and a seat, the bicycle being equipped with a bicycle shifting apparatus in accordance with the present invention;

Fig. 2 is a fragmentary, elevational view of the shifting apparatus attached to the handlebar of the bicycle depicted in Fig. 1, looking from the seat toward the handlebar;

Fig. 3 is a part elevational view, part cross-sectional view of the shifting apparatus depicted in Fig. 2, shown removed from the handlebar, taken along the line III-III of Fig. 2, the shifting apparatus having a control member, a release pawl and a drive pawl;

Figs. 4A-4I are views illustrating various positions of the release pawl, the drive pawl and the control member of the shifting apparatus depicted in Fig. 3, the release pawl, the drive pawl and the control member shown removed from the shifting apparatus for clarity;

Figs. 5A-5F are views illustrating two differing sprocket sets, one sprocket set shown in the upper portion of each of Figs. 5A-5F and another sprocket set shown in the lower portion of each of Figs. 5A-5F, the position of a chain derailleur is shown in each of Figs. 5A-5F with respect to the two sprocket sets, the position of the derailleur in Fig. 5A corresponding to the position of the control member depicted in Fig. 4A, the position of the derailleur in Fig. 5B corresponding to the position of the control member depicted in Fig. 4C, the position of the derailleur in Fig. 5C corresponding to the position of the control member depicted in Fig. 4D, the position of the derailleur in Fig. 5D corresponding to the position of the control member depicted in Fig. 4E, the position of the derailleur in Fig. 5E corresponding to the position of the control member depicted in Fig. 4F, and the position of the derailleur in Fig. 5F corresponding to the position of the control member depicted in Fig. 4G;

Fig. 6 is an elevational view of a prior art release pawl and corresponding prior art control member that are configured for use with a single sprocket set;

Fig. 7 is an elevational view similar to Fig. 6, showing a release pawl and corresponding control member in accordance with an alternate embodiment of the present invention, the release pawl and control member being configured for use with multiple sprocket sets.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Fig. 1 is a side view of a bicycle (1) in accordance with the present invention having a handlebar (18), a front derailleur (200) and a rear derailleur (7) and a seat (6). To control the position of the derailleur (200), a shifting apparatus (10) is installed on the handlebar (18). The detailed structure of shifting apparatus (10) is shown in Figs. 2 and 3. The shifting apparatus (10) includes a mounting bracket (14) for mounting the shifting apparatus (10) to a handlebar (18). However, it should be appreciated that the shifting apparatus could be mounted elsewhere on the bicycle. As shown in Fig. 2, the shifting apparatus (10) is configured to be mounted adjacent to a brake lever, the brake lever shown in dashed lines in Fig. 2. The shifting apparatus (10) also includes: a housing cover (22) which houses the shifting components; a main lever (26) for causing the shifting apparatus (10) to pull on an inner wire (28) (see Fig, 3) of a shifting cable (30); and a release lever (34) for causing the shifting apparatus to release the inner wire (28). Due to the proximity to the brake lever shown in Fig. 2, the shifting apparatus (10) is operated using two fingers. The bicycle rider may use a thumb to depress the main lever (26) and a forefinger to pull upward on the release lever (34), with respect to Fig. 2. In Fig. 3, the housing cover (22) has been removed for greater clarity.

A support frame (38) is formed with bracket (14) which secures the shifting apparatus (10) to the handlebar (18). The bracket (14) is adapted to be fastened to handlebar (18) by a mounting screw (40). A main pivot post (44) extends through an opening (48) in the support frame (38). A takeup element (52) is rotatably mounted to main pivot post (44) and is biased in a cable unwinding direction by a spring (60). A cable retainer (not shown) is fastened to the end of inner cable (28) and is retained by the takeup element (52) in a well known manner. Inner cable (28) is guided within a cable winding groove (68) during the shifting operation. A control member (72) is fixed to takeup element (52) so as to rotate integrally with it. As described in more detail below, control member (72) includes a plurality of large position retaining teeth (80a, 80b and 80c), a plurality of small positioning teeth (82a, 82b, 82c, 82d, 82e and 82f) and plurality of drive teeth (84) shown in Figs. 4A-4I, for rotating and controlling the position of takeup element (52) in conjunction with main lever (26) and release lever (34).

Release lever (34) is rotatably mounted to a release pivot post (92) which, in turn, is mounted to the support frame (38) and a cover (39) attached to the support frame (38). A spring (94) mounted between release lever (34) and release pivot post (92) for biasing release lever (34) to a home position (as shown in Fig. 2). A release pawl (98) is also rotatably mounted to the release pivot post (92) and is biased in a clockwise direction (with respect to Figs. 4A through 4I) by a clockwise pawl spring (102). Release pawl (98) shown in Figs. 4A-4I includes spaced apart jaws (104,106) for engaging the large and small position retaining teeth (80a-80c) and (82a-82f) on control member (72) in a manner discussed below. A release lever tab (not shown) on release lever (34) contacts a portion of release pawl (98) to pivot release the pawl with counter-clockwise movement (with respect to Figs. 4A-4I) of release lever (34). Details concerning the release lever tab (not shown) are similar to the operation and configuration of the shifting mechanism described in U.S. patent application serial number 08/588,659, filed January 19, 1996. The contents of U.S. patent application serial number 08/588,659 are provided as Appendix 1 hereto. This disclosure can also be found in the European equivalent of this application, EP 0785,128.

Main lever (26) is rotatably mounted to main pivot post (44) by a retainer nut (113). The post (44) and the nut (113) retain a spacer (114) on the post (44) such that the spacer (114) cannot rotate with respect to the cover (38) and the post (44). For instance, the post (44) is formed with an axially extending slot (not shown) and the spacer (114) is formed with a tab (not shown) which extends into the unillustrated slot in a manner well known to prevent rotation of the spacer (114). A spring (118) is retained between the spacer (114) and a base portion (26a) of the main lever (26). The base portion (26a) has a generally disk-like shape and is integrally formed with the main lever (26). One end (not shown) of the spring (118) engages the spacer (114) and another end (not shown) of the spring (118) engages the base portion (26a) for biasing main lever (26) to a home position (as shown in Fig. 2). A retainer plate (76) is held in place by the post (44) between the cover (39) and the control member (72), as shown in Fig. 3, such that the retainer plate (76) cannot rotate with respect to the cover (39). It should be understood that the control member (72) and the takeup element (52) are fixed to one another but are rotatable about the post (44) and are rotatable with respect to the cover (39), but the takeup element (52) is biased by the spring (60) in a counterclockwise direction (with respect to Figs. 4A-4I). A drive pawl (130) is mounted to a drive pivot post (134). The drive pivot post (134) extends through an arcuate slot (not shown) formed the cover (39). The drive pivot post (134) is further fixed to the base portion (26a) such that as the lever (26) is moved, the post (134) moves within the confines of the slot (not shown) in the cover (39). The drive pawl (130) is mounted on the post (134) but may rotate with respect to the post (134). The drive pawl (130) is biased in a clockwise direction (with respect to Figs. 4a-4I) by a spring (138), and both drive pawl (130) and spring (138) are retained on main pivot post (134) by, for instance, a C-clip (not shown).

Figs. 4A through 4I are views illustrating the relationship between and the movement of the control member (72), the release pawl (98) and drive pawl (130) with respect to one another. Figs. 4A through 4I and the following description further show how the control member (72), the release pawl (98) and drive pawl (130) cooperate with one another to selectively move the cable (28) and hence move the derailleur and chain (D) between a plurality of sprockets in a sprocket set, through engagement of the release pawl (98) and drive pawl (130) with the large and small position retaining teeth (80) and (82) and drive teeth (84).

In the embodiment depicted in Figs. 4A through 4I there are three large position retaining teeth (80a, 80b and 80c), each of the large position retaining teeth positioned to correspond to one sprocket in a sprocket set having three sprockets, such as the sprocket set shown in Figs. 5A through 5F, the sprocket set having sprockets (S1, S2 and S3) axially spaced apart as shown. Further, there is at least one small position retaining tooth (82f) formed between the large position retaining teeth (80c) and (80b), at least one small position retaining tooth (82e) formed between the large position retaining teeth (80b) and (80a), and a plurality of small position retaining teeth (82a, 82b, 82c, 82d) formed on a counterclockwise side of the large positioning retaining tooth (80a).

Most of the various positions of the control member (72) with the jaw (104) in engagement with one the large and small position retaining teeth (80) and (82) corresponds to at least one of the positions of a derailleur (200) shown in Figs. 5A through 5F, as is explained below. Each of Figs. 5A through 5F show two differing sprocket sets, one sprocket set shown in the upper portion of each of Figs. 5A-5F and another sprocket set shown in the lower portion of each of Figs. 5A-5F. The first sprocket set includes sprockets S1, S2 and S3. The second sprocket set includes sprockets S4, S5 and S6. The axial spacing between the sprockets S4, S5 and S6 is larger than the axial spacing between sprockets (S1, S2 and S3).

The operation of the shifting apparatus (10) is described below.

When the bicycle transmission is not in the process of being shifted, an engagement projection (140) of drive pawl (130) engages an abutment (144) shown Figs. 4A through 4F. The abutment (144) is formed on the retainer plate (76) such that the engagement projection (140) cannot engage any of the drive teeth (84) on the control member (72). When the drive chain is to be shifted to the next largest freewheel sprocket, then main lever (26) is rotated in the counterclockwise direction with respect to Fig. 2. The movement of the main lever (26) causes drive pawl (130) to move from the dotted line representation of the drive pawl (130) in Figs. 4B-4H and in the direction of the drive pawl (130) shown in solid lines in Figs. 4B-4H so that engagement projection (140) of drive pawl (130) moves radially inward

beyond the abutment (144) and drops into the gap between adjacent drive teeth (84) and (84), until engagement is made with one of the drive teeth (84). Once engagement is made with one of the drive teeth (84), the control member (72) is caused to rotate in a clockwise direction in response to further movement of the drive pawl (130).

The takeup element (52) and control member (72) then rotate in the clockwise direction, with respect to Figs. 4A-4I. Since release pawl (98) is pivotable about the release pivot post (92), release pawl (98) rotates counterclockwise when one of the large position retaining teeth (80b) or (80a) or one of the small position retaining teeth (82a) through (82f) passes by it as the control member (72) rotates in a clockwise direction, thus allowing contacting position retaining tooth to move to the other side of jaw (104). Thereafter, when main lever (26) is released, spring (118) causes main lever (26) to return to the position shown in Fig. 2, and drive pawl (130) retracts to the position shown in Fig. 4A in solid lines and in dotted lines in Figs. 4B-4H. Since takeup element (52) and control member (72) are biased in the counterclockwise direction by spring (60), engagement jaw (104) and any of the large or small positional retaining teeth prevents the control member (72) from rotating in a counterclockwise direction, thus maintaining takeup element (52) and the derailleur (200) in the desired position.

When the chain is to be shifted, for instance, to a smaller sprocket, release lever (34) is rotated in a clockwise direction, with respect to Fig. 2. The movement of the release lever (34) causes rotation of the pawl (98) in the counterclockwise direction, with respect to Figs. 4A-4I. Small amounts of rotation of the pawl (98) will retract the jaw (104) from engagement with any of the small teeth (84), and allow the control member (72) to rotate in a counterclockwise direction but will cause the jaw (104) to engage the first large position retaining teeth (80a, 80b or 80c) that approaches the jaw (104). Large movement of the pawl (98), such as that depicted in Fig. 4I, will bring the jaw (106) into position for contact with the first of either large position retaining teeth (80b) or (80c) that approaches the jaw (106), thus causing a downshift movement of the derailleur (200) from one larger sprocket to the next smaller sprocket. Thereafter, release of the release lever (34) will cause the biased pawl (98) to pivot such that the jaw (104) will engage the nearest large positioning tooth on a clockwise side of the jaw (104). Since engagement projection (140) of drive pawl (130) is resting on abutment (144), drive pawl (130) does not interfere with rotation of control member (72) during downshifting.

For example, if the release lever (34) has been completely depressed (a large movement) with the control member (72) in the position shown in Fig. 4C where the derailleur is aligned with the sprocket (S2) as shown in Fig. 5B, the subsequent movement of the pawl (98) and control member (72) will cause the jaw (104) disengage the large position retaining tooth (80b), as shown in Fig. 4I. Thereafter, the jaw (106) will make contact with the large position retaining tooth (80b). When release lever (34) is released, spring (94) causes release lever (34) to rotate back to the position shown in Fig. 1. Since release pawl (98) is biased in the clockwise direction by spring (102), release pawl (98) will rotate in the clockwise direction, and jaw (106) moves up the side of position retaining tooth (80b) until the tip of jaw (106) clears the tip of position retaining tooth (80b). When this occurs, control member (72), which is biased in the counterclockwise direction by spring (60), moves counterclockwise until position retaining tooth (80c) abuts against jaw (104) as shown in Fig. 4A, thus completing the downshifting operation.

With respect to Figs. 4A through 4I, the drive chain (D) is engaged with the smallest freewheel sprocket (S1) or (S4) in either sprocket set when the position retaining tooth (80c) abuts against jaw (104) of release pawl (98), as shown in Fig. 5A. The drive chain (D) is engaged with the freewheel sprocket (S2) when the position retaining tooth (80b) abuts against jaw (104) of release pawl (98), as shown in Fig. 5B. However, the drive chain (D) is engaged with the freewheel sprocket (S5) when the position retaining tooth (82e) abuts against jaw (104) of release pawl (98), as shown in Fig. 5C, and so on. The positions of the chain derailleur (200) shown in Figs. 5A through 5F correspond to the positions of the control member (72) depicted in Figs. 4A through 4I as follows:

1) the position of the derailleur (200) in Fig. 5A corresponding to the position of the control member (72) depicted in Fig. 4A,
2) the position of the derailleur (200) in Fig. 5B corresponding to the position of the control member (72) depicted in Fig. 4C,
3) the position of the derailleur (200) in Fig. 5C corresponding to the position of the control member (72) depicted in Fig. 4D,
4) the position of the derailleur (200) in Fig. 5D corresponding to the position of the control member (72) depicted in Fig. 4E,
5) the position of the derailleur (200) in Fig. 5E corresponding to the position of the control member (72) depicted in Fig. 4F, and
6) the position of the derailleur (200) in Fig. 5F corresponding to the position of the control member (72) depicted in Fig. 4G.

However, it should be understood that the dimensional relationship or axial spacing between the sprockets S1, S2 and S3 and the sprockets S4, S5 and S6 are for example only. Other spacings, number of sprockets and the correspondence between position retaining teeth and sprockets may be varied or altered depending upon design requirements.

In the manner described above, the present invention allows for shifting from a small sprocket such as the sprocket (S1) stepwise to a larger sprocket (S2) with simple motion of the lever (26) using indexing provided by the large position retaining teeth (80c, 80b and 80c). Further, in the event that the shifting mechanism is used with a sprocket set such as the sprocket set having sprockets (S4, S5 and S6) having large axial spacing between the sprockets, the small position retaining teeth (82a-82f) provide additional accurate indexing. For downshifting, the shape of the pawl (98) and the size of the jaws (104) and (106) are such that upon downshifting, movement of the control member (72) will be stepwise between adjacent large position retaining teeth (80a, 80b, 80c) since upon movement of the lever (34) the jaws (104) and (106) will only engage the large position retaining teeth (80a, 80b or 80c) one at a time. Therefore, for upshifting to a larger sprocket, the present invention allows for both large and small positional changes of the control member (72) in accordance with the movement of the drive pawl (130) and the spacing between both large and small position retaining teeth. But for downshifting, the present invention only allows large movements of the control member (72) between adjacent large position retaining teeth (80a, 80b and 80c) for rapid downshifting often required by bicycle riders.

When a bicycle derailleur mechanism is shifted, the amount of displacement of the derailleur may vary depending upon the size requirements of the chain sprockets employed. In a derailleur/freewheel configuration, this is caused in part by the variable distance between successive freewheel gears. In an indexed shifting apparatus, this variable displacement is accommodated by setting the position retaining teeth at different spacing from each other to correspond to the spacing between the sprockets in a sprocket set. However, because various types of sprocket sets are employed currently for front derailleurs, the present invention is necessary for use with a variety of sprockets sets. With the sprocket set shown in the upper half of each of Figs. 5A through 5F, the large position retaining teeth provide accurate positioning of the derailleur (200). Further, in the same shifting apparatus, may be used with the sprocket set shown in the lower half of each of Figs. 5A through 5F without modification or alteration.

To further illustrate the present invention, and to show an alternate embodiment, Figs. 6 and 7 are provided to demonstrate the differences between the present invention and the prior art. Fig. 6 shows a release pawl (300) and a control member (310) from a prior art shifting apparatus. There are four position retaining teeth (380) formed on the control member (310). The first three position retaining teeth (380) correspond generally to three sprockets of a sprocket set. The control member (310) may only be reliably used with a sprocket set whose sprockets are spaced apart in harmony with the spacing of the position retaining teeth (380). No other sprocket set may be reliably be used with the control member (310).

In Fig. 7, on the other hand, an alternate embodiment of the present invention is shown where a control member (72') is shown with a plurality of large position retaining teeth, a plurality of small positioning teeth and plurality of drive teeth. In a manner similar to the above described embodiment of the present invention, the control member (72') may be used with a variety of sprocket sets having various axial spacings between sprockets. The large position retaining teeth may correspond to a popular sprocket set employed on a large number of bicycles, while the small position retaining teeth may correspond generally to a variety of differing sprocket sets where those sprocket sets have axial spacing between sprockets that differs from the popular sprocket set.

Various details of the invention may be changed without departing from its spirit nor its scope. Furthermore, the foregoing description of the embodiments according to the present invention is provided for the purpose of illustration only, and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

Appendix 1

SHIFTING APPARATUS FOR BICYCLES

BACKGROUND OF THE INVENTION

The present invention is directed to shifting apparatus for bicycles and, more particularly, to a shifting device which is more compact yet easier to use than known shifting devices.

A known indexed shifting apparatus for bicycles is disclosed in U.S. Patent No. 5,203,213. As shown in Figs. 3 and 4 of that patent, this type of shifting device includes a support shaft (11) fixed to a bracket (B) mounted on a handlebar; a takeup reel (2) rotatably mounted on the support shaft (11) for alternately pulling and releasing a control cable (I); a first control lever (4) pivotable about the support shaft (11) for causing the takeup reel (2) to pull the control cable (I); and a second control lever (7) for causing the takeup reel (2) to release the control cable (I). The first control lever (4) engages feed teeth (21) on takeup reel (2) through a feed pawl (41) to cause the takeup reel (2) to rotate in the cable pulling direction. The second control lever (7) engages two sets of position retaining teeth (31,61) on takeup reel (2) through two pawls (32,62) to cause the takeup reel to rotate in the cable release direction. The first control lever (4) and the second control lever (7) are both mounted at a position below the handlebar for operation by the index finger and thumb of a cyclist's hand.

Such a bicycle shifting apparatus operates quite satisfactorily for many users. However, the construction of the shifting apparatus does present some disadvantages. For example, the requirement of two pawl mechanisms used to release the control cable increases the cost of manufacture and produces a more complicated and heavier structure. The added components also increase the overall size of the shifting device, either in thickness or diameter. The increased size tends to lower the aesthetic appearance of the shifting device.

Attempts to construct single pawl release mechanisms for indexed bicycle shifting

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devices with many speeds (e.g., seven or more) have usually failed. One problem arises from the fact that the amount of cable pull for each gear varies. This requires position retaining teeth with varying pitch between adjacent teeth, and the pawl which engages the position retaining teeth must be designed to accommodate the variable pitch. However, as the number of speeds increase, the pitch between the position retaining teeth must either decrease accordingly, or else the size of the shifting device must be increased. Increasing the size of the shifting apparatus is undesirable for obvious reasons. Decreasing the pitch of the position retaining teeth requires a corresponding decrease in the size of the position retaining pawl. However, as the pawl size decreases the thickness of the pawl must necessarily decrease. To accommodate the high operating forces encountered in the typical release mechanism, the pawl must then be fabricated from sintered metal or through some other high cost method.

Furthermore, the location of the shift levers below the handlebar tend to impede high performance operation of the shifting device. Since the handlebar tends to obstruct the view of the shift levers, especially the shift lever operated by the index finger, inexperienced users, users without substantial familiarity with the location of the components, or users without substantial manual dexterity may need to visually assure themselves of the location of the shift levers or grope around before properly locating the shift levers. This wastes time and may annoy such users. Furthermore, the location of the shift levers make it impracticable to shift and brake at the same time. This limitation decreases the ability of racers to compete effectively and impedes the ability of other high performance cyclists who may wish to brake and shift at the same time.

SUMMARY OF THE INVENTION

The present invention is directed to a shifting apparatus for a bicycle which is simpler in construction and more compact than known shifting devices, and which also facilitates high performance riding. Simply stated, the shifting apparatus of the present invention reduces its size by using only a single pawl mechanism to release the control cable. To facilitate operation of the control levers, the control levers may be oriented so that the brake operating unit (for example, either the mounting bracket or the brake lever) is disposed between the control

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levers. This allows at least one control lever to be in ready view of the cyclist and allows simultaneous operation of the brake and shifting apparatus.

More specifically, in one embodiment of the present invention directed to an apparatus for operating a bicycle transmission shifting device having an operating component for mounting to a bicycle in close proximity to a brake operating unit for alternately pulling and releasing a transmission element, a first lever is mounted to the operating component for movement which causes the operating component to pull the transmission element, and a second lever is mounted to the operating component for movement which causes the operating component to release the transmission element. The first lever and the second lever are mounted to the operating component so that the brake operating unit is disposed between the first lever and the second lever when the shifting device is mounted to the bicycle. If desired. the first lever may be disposed above the brake operating unit where it is readily visible, and the second lever may be disposed below the brake operating unit in a manner which is also visible to the user.

In order to be able to construct the shifting device with only a single pawl for the release mechanism, the takeup element for the transmission element includes a control member having a plurality of position retaining teeth for engaging the single release pawl, wherein a pitch between at least two pairs of the plurality of position retaining teeth is a constant value. To accommodate the varying cable pull requirements of an index shifting system, the cable winding surface of the takeup element has a nonuniform shape. For some applications this may mean that the winding surface has a progressively increasing radius from a pivot point of the takeup element.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a top view of a particular embodiment of a bicycle shifting apparatus according to the present invention;

Fig. 2 is a cross-sectional view of the shifting apparatus shown in Fig. 1;

Fig. 3 is an exploded view of the shifting apparatus shown in Fig. 1;

Fig. 4 is a view illustrating the position of the pawls and control member shown in Fig. 3;

Figs. 5A-5E illustrate a release operation of the shifting apparatus shown in Fig. 3;

Fig. 6 is a perspective view of another embodiment of a shifting apparatus according to the present invention; and

Fig. 7 is a cross-sectional view of the shifting apparatus shown in Fig. 6.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Fig. 1 is a top view of a particular embodiment of a bicycle shifting apparatus (10) according to the present invention. Shifting apparatus (10) includes a mounting bracket (14) for mounting the shifting apparatus (10) to a handlebar (18) or other structural member of a bicycle; a housing (22) which houses the shifting components; a main lever (26) for causing the shifting apparatus (10) to pull on an inner wire (28, Fig. 2) of a shifting cable assembly (30); and a release lever (34) for causing the shifting apparatus to release the inner wire (28).

The detailed structure of shifting apparatus (10) is shown in Figs. 2 and 3. A lower cover (38) is mounted to bracket (14) for forming the lower portion of housing (22), and bracket (14) is adapted to be fastened to handlebar (18) by a mounting screw (40). A main pivot post (44) extends through an opening (48) in mounting bracket (14). A takeup element (52) is rotatably mounted to main pivot post (44) through a bushing (56) and is biased in a cable unwinding direction by a spring (60). A cable retainer (64) is fastened to the end of inner cable (28) and is retained by an abutment (66) formed in takeup element (52) in a well known manner. Inner cable (28) is guided within a cable winding groove (68) during the shifting operation. A control member (72) is fixed to takeup element (52) so as to rotate integrally with it, and a retainer plate (76) is mounted over control member (72). As described in more detail below, control member (72) includes a plurality of position retaining teeth (80) and a plurality of drive teeth (84) for rotating and controlling the position of takeup element (52) in conjunction with main lever (26) and release lever (34). An upper cover (88) is mounted to bracket (14) for forming the upper portion of housing (22).

Release lever (34) is rotatably mounted to a release pivot post (92) which, in turn, is

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mounted to bracket (14). A spring (94) mounted between release lever (34) and release pivot post (92) for biasing release lever (34) to a home position (shown by a solid line in Fig. 1). A release pawl (98) is also rotatably mounted to release pivot post (92) and is biased in a clockwise direction by a release pawl spring (102). Release pawl (98) includes spaced apart jaws (104,106) for engaging position retaining teeth (80) on control member (72) in a manner discussed below. Release pawl (98) and release pawl spring (102) are retained on release pivot post (92) by a C-clip (110). A release lever tab (101) on release lever (34) cooperates with a pawl tab (103) on release pawl (98) to pivot release pawl counterclockwise in response to counterclockwise movement of release lever (34).

Main lever (26) is rotatably mounted to main pivot post (44) by a bushing (112) and a retainer screw (113). A screw cover (115) is mounted above screw (113). A spacer (114) is disposed between main lever (26) and retainer plate (76), and a spring (118) is mounted between main lever (26) and a spring tab (122) on retainer plate (76) for biasing main lever (26) to a home position (shown by a solid line in Fig. 1). A drive pawl (130) is mounted to a drive pivot post (134) which, in turn, is mounted to main lever (26). Drive pawl (130) is biased in a clockwise direction by a spring (138), and both drive pawl (130) and spring (138) are retained on main pivot post (134) by a C-clip (142).

Fig. 4 is a view illustrating the detailed structure of takeup element (52) and control member (72), and how the release pawl (98) and main pawl (130) cooperate with position retaining teeth (80) and drive teeth (84), respectively. In this embodiment, there are eight position retaining teeth (80) and eight drive teeth (84) to accommodate an eight speed bicycle transmission. Jaws (104,106) are spaced apart by a distance approximately equal to a distance between adjacent position retaining teeth (80). To facilitate the following discussion, it will be assumed that the bicycle transmission in this example is a derailleur/freewheel combination wherein a derailleur moves a drive chain from one freewheel sprocket to another. Of course, other transmissions could be used, if desired. Since the takeup element (52) is biased in the counterclockwise direction by spring (60), the drive chain is engaged with the smallest freewheel sprocket when the position retaining tooth (80H) abuts against jaw (104) of release pawl (98), the drive chain is engaged with the second smallest freewheel sprocket when the position retaining tooth (80G) abuts against jaw (104) of release pawl (98), and so on until the

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chain is engaged with the largest freewheel sprocket wherein the position retaining tooth (80A) abuts against jaw (104) of release pawl (98).

When the bicycle transmission is not in the process of being shifted, an engagement projection (140) of drive pawl (130) rests on an abutment (144) of retainer plate (76). When the drive chain is to be shifted to the next largest freewheel sprocket, then main lever (26) is rotated in the clockwise direction to the position shown by broken lines in Fig. 1. This causes drive pawl (130) to move in the direction of the arrow shown in Fig. 4 so that engagement projection (140) of drive pawl (130) moves beyond the abutment (140) on retainer plate (76), drops into the gap between drive tooth (84F) and (84G), and presses against the side of drive tooth (84G). Takeup element (52) and control member (72) then rotates in the clockwise direction. Since release pawl (98) is rotatably mounted to release pivot post (92), release pawl (98) rotates counterclockwise when position retaining tooth (80F) presses against it, thus allowing position retaining tooth (80F) to move to the other side of jaw (104). Thereafter, when main lever (26) is released, spring (118) causes main lever (26) to return to the position shown in solid lines in Fig. 1, and drive pawl (130) retracts to the position shown in Fig. 4. Since takeup element (52) and control member (72) are biased in the counterclockwise direction by spring (60), control member begins to rotate. However, rotation of control member (72) stops when position retaining tooth (80F) abuts against jaw (104), thus maintaining takeup element (52) in the desired position.

When the chain is to be shifted to a smaller gear, release lever (34) is rotated counterclockwise to the position shown in broken lines in Fig. 1. This causes release lever tab (101) to press against pawl tab (103) to rotate pawl (98) in the counterclockwise direction. Figs. 5A-5E show the movement of release pawl (98) in the case where the chain is to be shifted from the second smallest sprocket (the position shown in Fig. 4) to the smallest sprocket. Initially, position retaining tooth (80G) abuts against jaw (104) as shown in Figs. 4 and 5A. As release pawl (98) rotates counterclockwise, jaw (104) moves up the side of position retaining tooth (80G) until the tip of jaw (104) clears the tip of position retaining tooth (80G). When this occurs, control member (72), which is biased in the counterclockwise direction by spring (60), moves counterclockwise until position retaining tooth (80F) abuts against jaw (106) as shown in Fig. 5C. Since engagement projection (140) of drive pawl (130)

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is resting on abutment (144) of retainer plate (76), drive pawl (130) does not interfere with rotation of control member (72). When release lever (34) is released, spring (94) causes release lever to rotate back to the position shown in solid lines in Fig. 1, thus causing release lever tab (101) to disengage from pawl tab (103) as shown in Fig. 5D. Since release pawl is biased in the clockwise direction by spring (102), release pawl (98) begins to rotate in the clockwise direction, and jaw (106) moves up the side of position retaining tooth (80F) until the tip of jaw (106) clears the tip of position retaining tooth (80F). When this occurs, control member (72), which is biased in the counterclockwise direction by spring (60), moves counterclockwise until position retaining tooth (80H) abuts against jaw (104) as shown in Fig. 5E, thus completing the shifting operation.

When a bicycle transmission is shifted, the amount of displacement of the transmission cable or other transmission element varies for each gear. In a derailleur/freewheel transmission, this is caused in part by the variable distance between successive freewheel gears. In an indexed shifting apparatus, this variable displacement is accommodated by setting the position retaining teeth at different spacing from each other. This means that the release pawl must be constructed to accommodate the widest spacing between the position retaining teeth, thus increasing the size of the shifting apparatus. Furthermore, as the number of speeds increase, the spacing between the position retaining teeth must either decrease accordingly, or else the size of the shifting device must be increased. Decreasing the pitch of the position retaining teeth requires a corresponding decrease in the size of the position retaining pawl. However, as the pawl size decreases the thickness of the pawl must necessarily decrease, particularly the pawl jaws such as jaws (104,106) in release pawl (98). To accommodate the high operating forces encountered in the typical release mechanism, the pawl must then be fabricated from sintered metal or through some other high cost method. As the number of speeds continue to increase, the jaws become too thin, and a single pawl simply cannot be made to satisfactorily perform the function.

The present invention solves this problem by setting a constant pitch (or space) between adjacent position retaining teeth despite the requirement of variable displacement of the transmission cable. In this embodiment, there is a constant pitch between position retaining teeth (80B,80C), (80C,80D), (80D,80E), (80E,80F), and (80F,80G). For this particular

embodiment, the constant pitch is 18°, but this is not critical. The actual pitch will depend on the particular application. To accommodate the requirement of variable displacement of the transmission cable, the winding surface (68) is formed with an irregular shape. In this embodiment, the winding surface (68) has an increasing radius in the counterclockwise direction. Thus, the amount of cable displacement will vary despite the constant pitch of the position retaining teeth, and this variable displacement is accomplished without increasing the overall size of the shifting apparatus. Of course, the actual shape of the winding surface will also depend on the application, and it may either decrease in radius, remain constant, be flat, have a temporary spike, or have some other shape depending upon the application.

It should be noted that not all pairs of position retaining teeth need to have a constant pitch. For example, there is a pitch of 25° between position retaining teeth (80G,80H), and a pitch of 28.8° between position retaining teeth (80A,80B). The number of pairs of position retaining teeth having a constant pitch depends on the space savings desired, the number of speeds in the bicycle transmission, and other design considerations. In this embodiment, the pitch of the position retaining teeth (80) allow control member (72) to accommodate seven or more speeds, and the control member may have a diameter of 30 mm or less

Fig. 6 is a top view of an alternative embodiment of a shifting device (200) according to the present invention. In this embodiment, an operation component (204) of shifting device (206) is mounted in close proximity to a brake operating unit (208) such that a first operating lever (212) is disposed below brake operating unit (208) and a second operating lever (216) is disposed above brake operating unit (208). In this embodiment, first lever (212) functions as the main lever and second lever (216) functions as the release lever, with movement indicated by the arrows, but the functions of the levers and their directions of movement could be reversed or altered as desired. Furthermore, the levers (212,216) could be disposed above or below the brake operating unit (208) at any location. For example, the levers (212,216) could be disposed above or below a mounting bracket (220), a brake lever (224), or any other portion of brake operating unit (208). This configuration makes it possible to shift and brake at the same time, and the levers can be seen quite easily for high performance operation.

Fig. 7 is a cross sectional view of the shifting apparatus shown in Fig. 6. From

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inspection is should be readily apparent that the construction of operation component (204) is substantially the same as in the first embodiment, except the location of the main lever and the release lever has been reversed. Main pivot post (44) has been lengthened to accommodate bracket (14) which, in this embodiment, has been formed integrally with the brake operating unit (208). The components which correspond to the main components in the first embodiment are numbered the same, so a detailed description of them shall be omitted.

While the above is a description of various embodiments of the present invention, further modifications may be employed without departing from the spirit and scope of the present invention. For example, the embodiment shown in Figs. 6-7 may use a conventional multiple release pawl operation component. Components shown as separate parts may be integrally formed, and the shape, orientation or location of the components may be altered as desired. Although a wire (28) was shown as a winding transmission element, other transmission elements (chain, belt, etc.) Also may be used.

Thus, the scope of the invention should not be limited by the specific structures disclosed. Instead, the true scope of the invention should be determined by the following claims. Of course, although labeling symbols are used in the claims in order to facilitate reference to the figures, the present invention is not intended to be limited to the constructions in the appended figures by such labeling.

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WHAT IS CLAIMED IS:

1 An apparatus for operating a bicycle transmission shifting device (200) having an operating component (204) for mounting to a bicycle in close proximity to a brake operating unit (208) for alternately pulling and releasing a transmission element (28) comprising:

a first lever (212) mounted to the operating component (204) for movement which causes the operating component (204) to pull the transmission element (28);

a second lever (216) mounted to the operating component (204) for movement which causes the operating component (204) to release the transmission element (28); and

wherein the first lever (212) and the second lever (216) are mounted to the operating component (204) so that the brake operating unit (208) is disposed between the first lever (212) and the second lever (216) when the shifting device (200) is mounted to the bicycle.

2. The apparatus according to claim 1 wherein the first lever (212) and the second lever (216) are mounted to the operating component (204) so that a mounting bracket (220) of the brake operating unit (208) is disposed between the first lever (212) and the second lever (216) when the shifting device (200) is mounted to the bicycle.

3. The apparatus according to claim 1 wherein the first lever (212) and the second lever (216) are mounted to the operating component (204) so that an operating lever (224) of the brake operating unit (208) is disposed between the first lever (212) and the second lever (216) when the shifting device (200) is mounted to the bicycle.

4. The apparatus according to claim 1 wherein the first lever (212) is mounted to the operating component (204) so that movement of the first lever (212) in a first direction causes the operating component (204) to pull the transmission element (28), wherein the second lever (216) is mounted to the operating component (204) so that movement of the second lever (216) in a second direction causes the operating component (204) to release the transmission element (28), and wherein the first direction is opposite the second direction.

5. A bicycle transmission shifting apparatus comprising:

a fixed member (14);

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a takeup element (52) rotatably supported on the fixed member (14) for alternately rotating in a transmission element winding direction and in a transmission element unwinding direction, the takeup element (52) being biased in the transmission element unwinding direction;

a first control member (26) for engaging the takeup element (52) through a one-way transmission unit (72,84,130,144) for rotating the takeup element (52) in the transmission element winding direction;

a position retaining unit (72,80,98) coupled to the takeup element (52) and being switchable between a position retaining state for retaining the takeup element (52) in a selected position and a position releasing state for allowing the takeup element (52) to rotate in the transmission element unwinding direction, the position retaining unit (72,80,98) including only a single position retaining pawl (98) coupled to the takeup element (52); and

a second control member (34) for engaging the position retaining unit (72,80,98) for switching the position retaining unit (72,80,98) between the position retaining state and the position releasing state.

6. The apparatus according to claim 5 further comprising a control member (72) coupled to the takeup element (52) and having a plurality of position retaining teeth (80) for engaging the pawl (98), and wherein a pitch between at least two pairs of the plurality of position retaining teeth (80) is a constant value.

7. The apparatus according to claim 6 wherein the takeup element (52) includes a winding surface (68) having a nonuniform shape.

8. The apparatus according to claim 6 wherein the winding surface (68) has a progressively increasing radius from a pivot point of the takeup element (52).

9. The apparatus according to claim 6 wherein the control member (72) includes at least seven serially disposed position retaining teeth (80), wherein a pitch between each adjacent pair of a contiguous six of the seven position retaining teeth (80B-80G) is a constant value, and wherein a pitch between a seventh position retaining tooth (80A,80H) and a position retaining tooth (80B, 80G) adjacent to it from the contiguous six position retaining

teeth (80B-80G) is different from the constant value.

10. The apparatus according to claim 9 wherein the constant value is approximately equal to 18°.

11. The apparatus according to claim 9 wherein the pitch between the seventh position retaining tooth (80A,80H) and the position retaining tooth (80B,80G) adjacent to it is greater than the constant value.

12. The apparatus according to claim 6 wherein the control member (72) includes at least eight position retaining teeth (80) serially disposed in a numerical order, wherein a pitch between each adjacent pair of a middle six of the eight position retaining teeth (80B-80G) is a constant value, wherein a pitch between a first position retaining tooth (80A) and a second position retaining tooth (80B) is different from the constant value, and wherein a pitch between a seventh position retaining tooth (80G) and an eighth position retaining tooth (80H) is different from the constant value.

13. The apparatus according to claim 12 wherein the constant value is approximately equal to 18°.

14. The apparatus according to claim 12 wherein the pitch between the first position retaining tooth (80A) and the second position retaining tooth (80B) is greater than the constant value, and wherein the pitch between the seventh position retaining tooth (80G) and the eighth position retaining tooth (80H) is greater than the constant value.

15. The apparatus according to claim 6 wherein the control member (72) includes a plurality of drive teeth (84), and wherein the one-way transmission unit (72,84,130,144) comprises a drive pawl (130) coupled to the first control member (26) for engaging the plurality of drive teeth (84) in response to movement of the first control member (26).

16. The apparatus according to claim 6 wherein the position retaining pawl (98) includes two spaced apart claw members (104,106).

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17. The apparatus according to claim 16 wherein the two claw members (104,106) are spaced apart by a distance approximately equal to a distance between a pair of adjacent position retaining teeth (80).

18. The apparatus according to claim 17 wherein the position retaining pawl (98) is rotatably mounted to the fixed member (14), and wherein the second control member (34) engages the position retaining pawl (98) so that the position retaining pawl (98) rotates in response to movement of the second control member (34).

19. A bicycle transmission shifting apparatus comprising:

a mounting member (14);

a takeup element (52) rotatably supported on the mounting member (14) for alternately rotating in a transmission element winding direction and in a transmission element unwinding direction, the takeup element (52) being biased in the transmission element unwinding direction;

a position retaining element (72) disposed on the takeup element for rotation therewith, the position retaining element (72) having a plurality of drive teeth (84) and a plurality of position retaining teeth (80);

a first control member (26) for engaging the plurality of drive teeth (84) through a one-way transmission unit (130,144) for rotating the takeup element (52) in the transmission element winding direction; and

a second control member (34) rotatably coupled to the mounting member (14) for engaging a single position retaining pawl (98), the position retaining pawl (98) engaging the plurality of position retaining teeth (80), the position retaining pawl (98) including two claw members (104,106) that are spaced apart by a distance approximately equal to a distance between a pair of adjacent position retaining teeth (80).

20. The apparatus according to claim 19 wherein the one-way transmission unit (130,144) comprises:

a drive pawl (130) coupled to the first control member (26) for engaging the plurality of drive teeth (84) in response to movement of the first control member (26); and

a drive pawl positioning member (144) disposed in close proximity to the plurality of

drive teeth (84) for maintaining the drive pawl (130) out of engagement with the plurality of drive teeth (84) when the first control member (26) is disposed in a first control member home position and for allowing the drive pawl (130) to engage at least one of the plurality of drive teeth (84) when the first control member (26) is moved away from the first control member home position.

21. The apparatus according to claim 20 further comprising:

a first spring (118) for biasing the first control member (26) to the first control member home position; and

a second spring (94) for biasing the second control member (34) to a second control member home position.

22. The apparatus according to claim 21 wherein the first control member (26) is adapted to automatically return to the first control member home position when the first control member (26) is released by a user, and wherein the second control member (34) is adapted to automatically return to a second control member home position when the second control member (34) is released by the user.

SHIFTING APPARATUS FOR BICYCLES

ABSTRACT OF THE DISCLOSURE

An apparatus for operating a bicycle transmission shifting device having an operating component for mounting to a bicycle in close proximity to a brake operating unit for alternately pulling and releasing a transmission element, a first lever is mounted to the operating component for movement which causes the operating component to pull the transmission element, and a second lever is mounted to the operating component for movement which causes the operating component to release the transmission element. The first lever and the second lever are mounted to the operating component so that the brake operating unit is disposed between the first lever and the second lever when the shifting device is mounted to the bicycle. In order to be able to construct the shifting device with only a single pawl for the release mechanism, the takeup element for the transmission element includes a control member having a plurality of position retaining teeth for engaging the single release pawl, wherein a pitch between at least two pairs of the plurality of position retaining teeth is a constant value. To accommodate the varying cable pull requirements of an index shifting system, the cable winding surface of the takeup element has a nonuniform shape.

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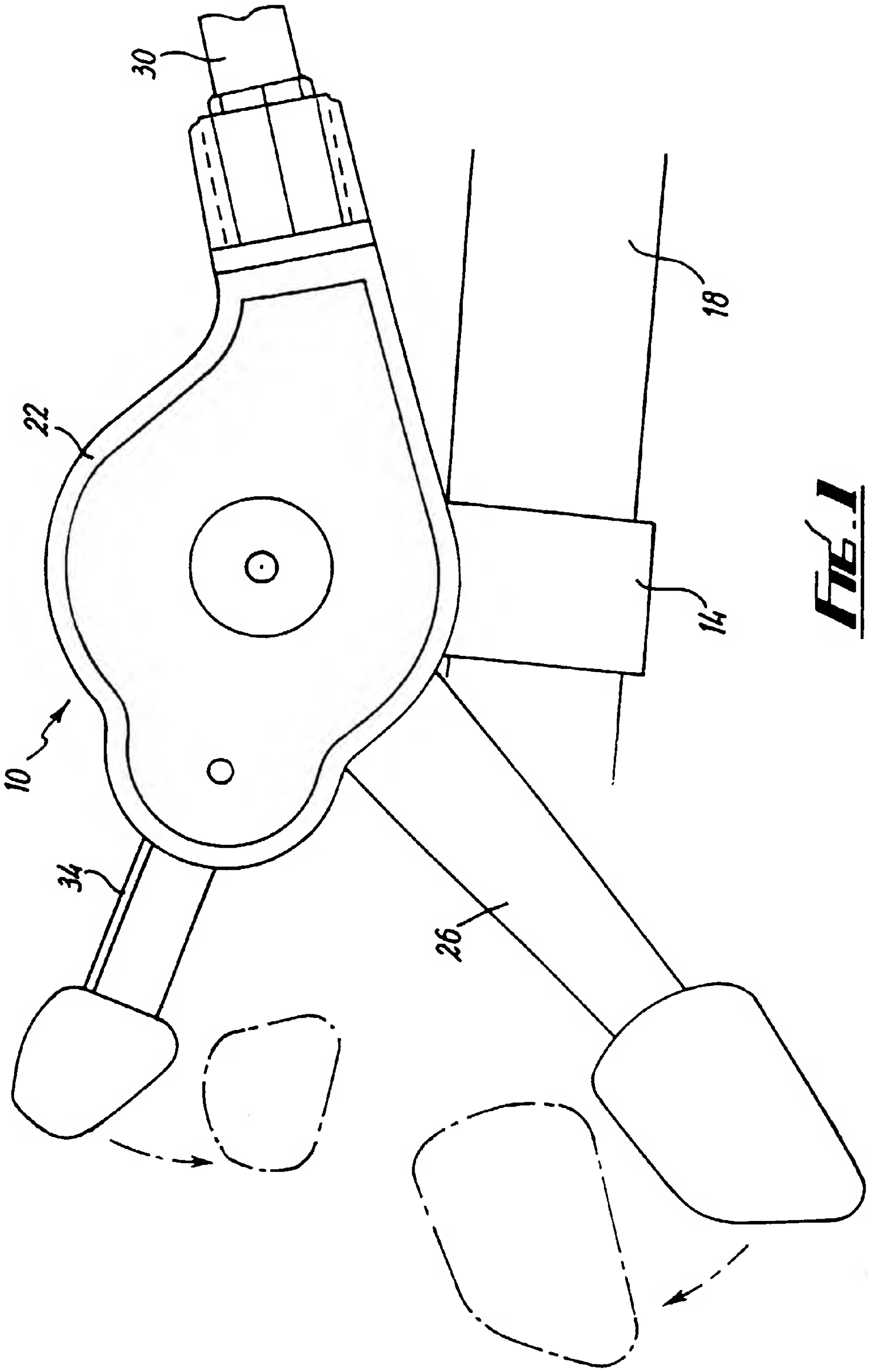

FIG. 1

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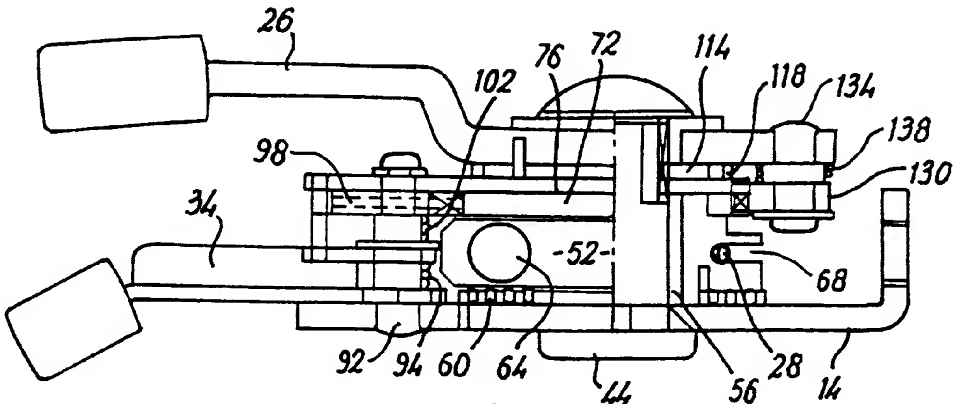

FIG. 2

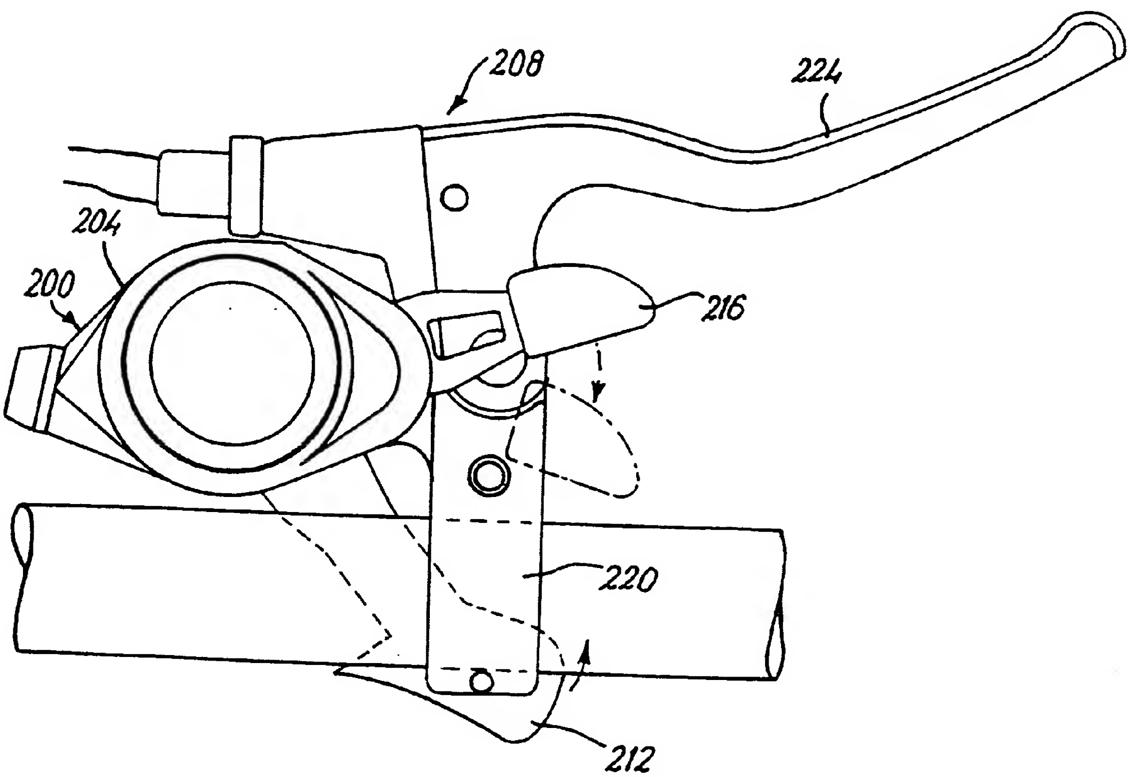

FIG. 6

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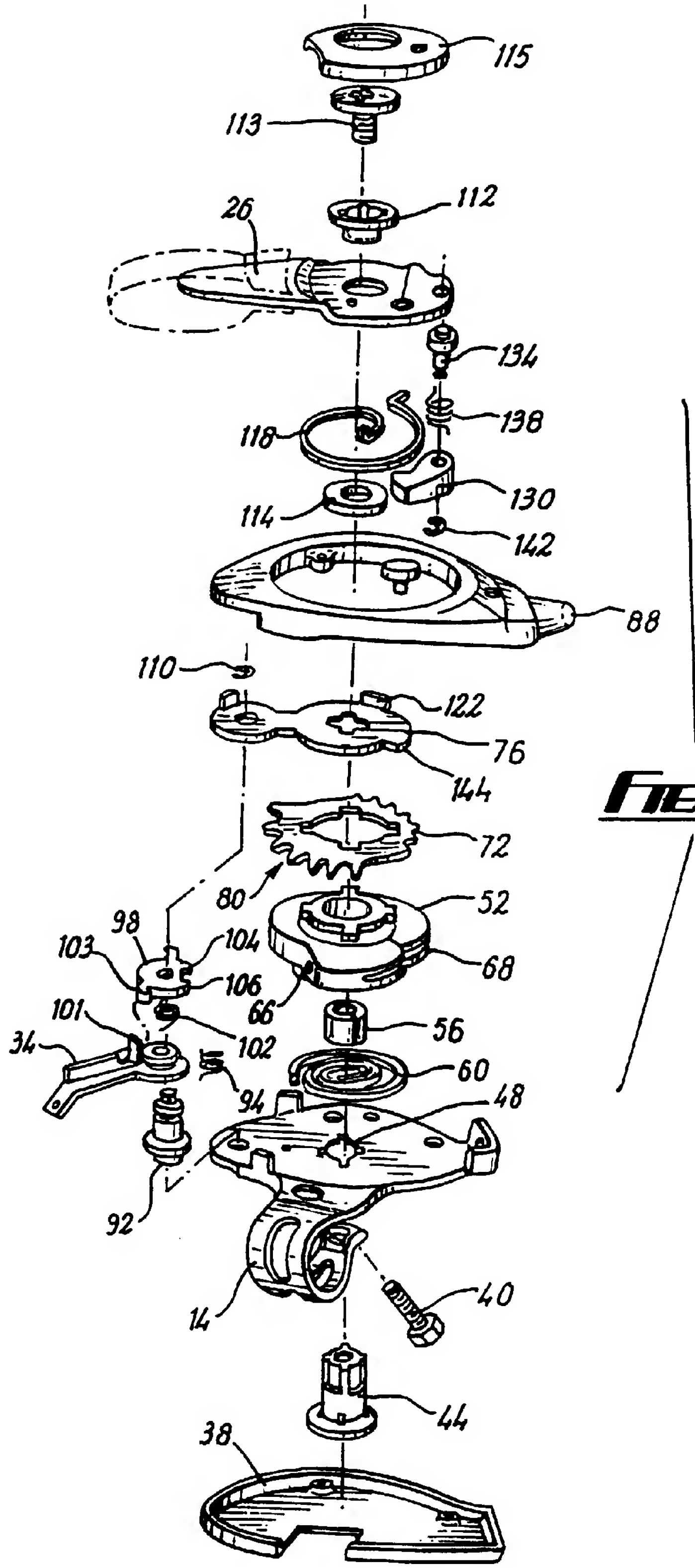

FIG. 3

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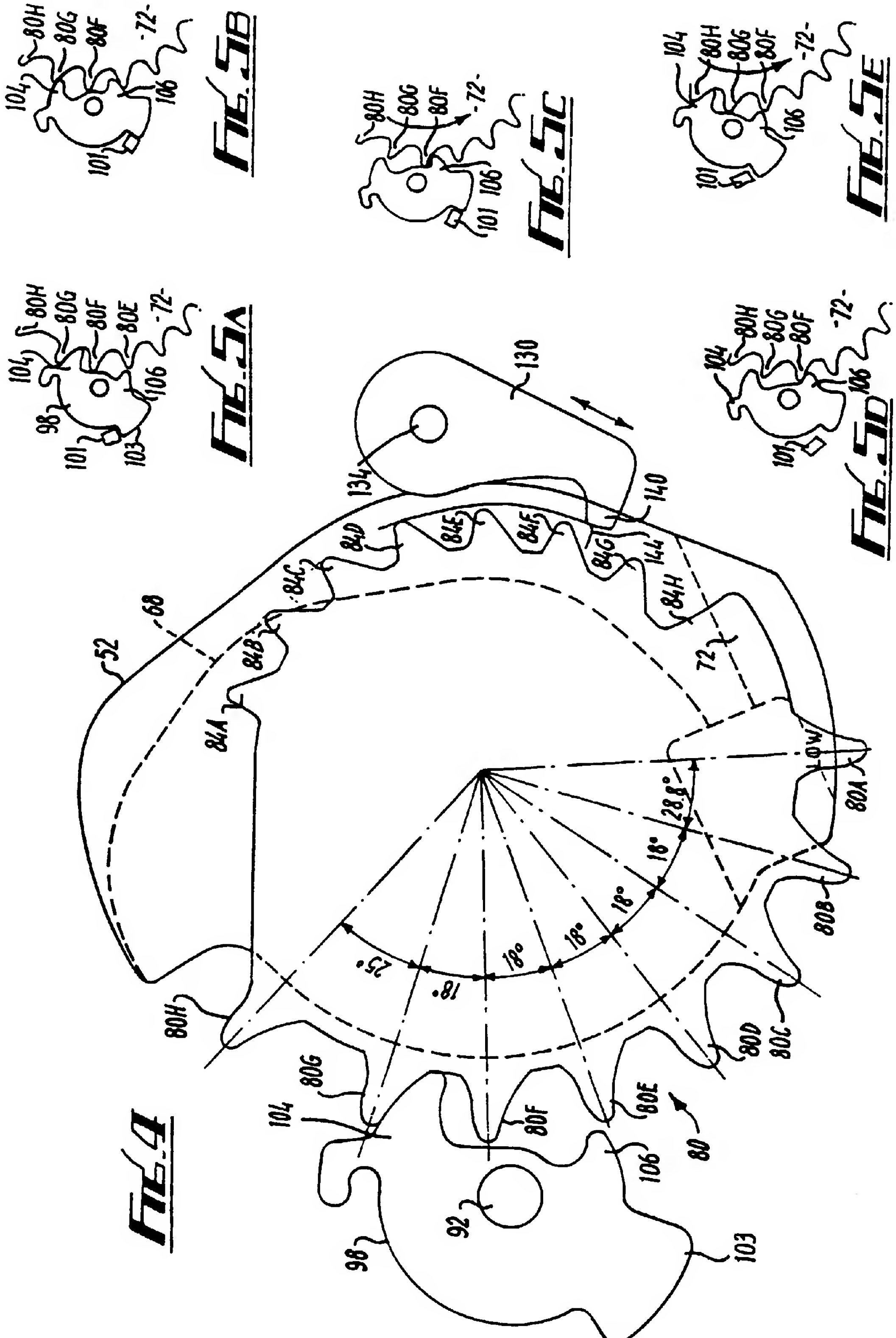

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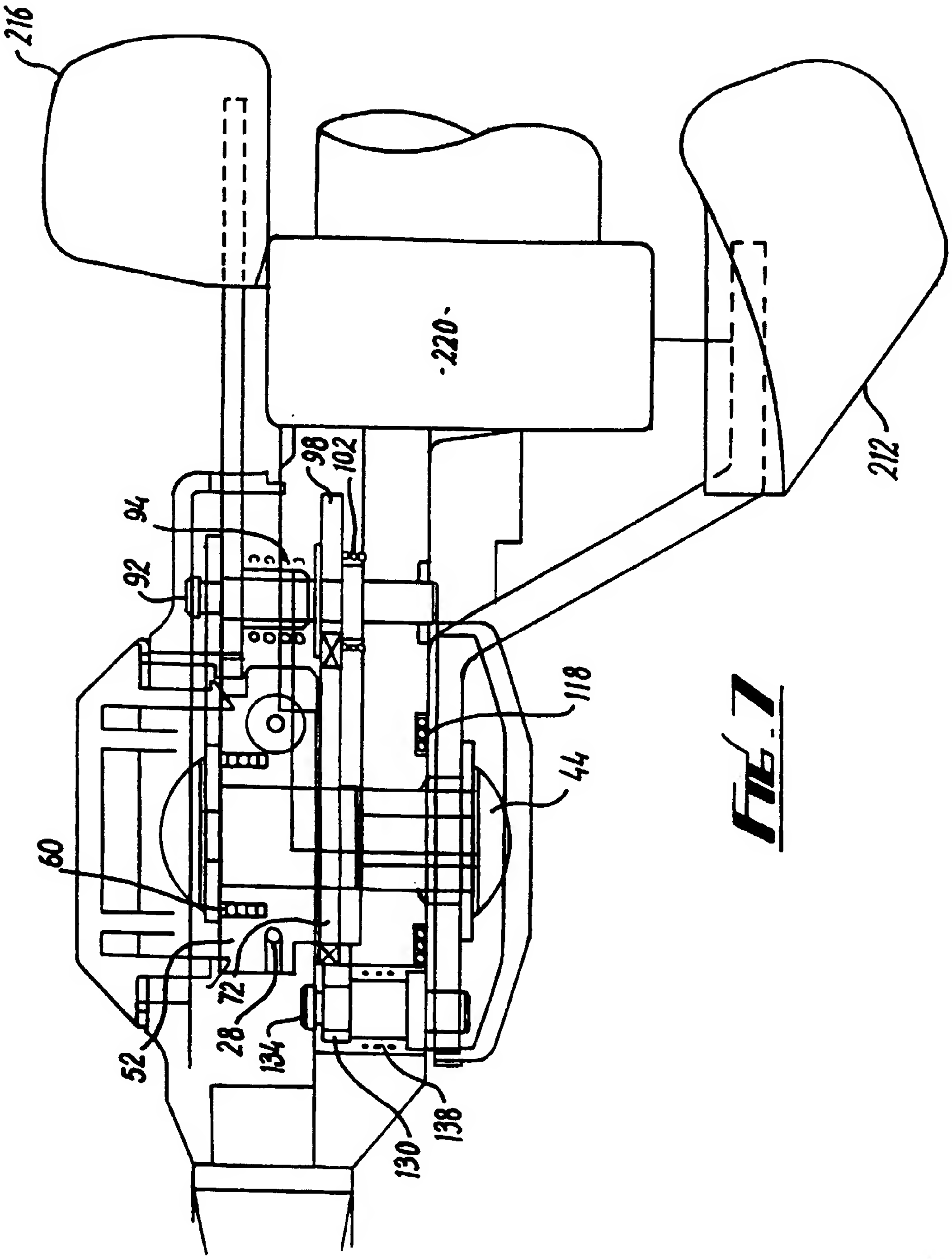

FIG. 7

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Claims

1. An apparatus for shifting positions of a bicycle derailleur, comprising:

    a shifting mechanism for selectively moving a chain derailleur a plurality of positions corresponding to positions of sprockets of plurality of differing sprocket sets;

    a control member mounted for selective rotational movement within said shifting mechanism, said control member being formed with a plurality of large position retaining teeth and a plurality of small position retaining teeth, at least one of said small position retaining teeth formed between each adjacent ones of said large position retaining teeth, each of said large position retaining teeth being positioned on said control member to correspond to the positions of the sprockets in a first of the plurality of differing sprocket sets, and at least one of said small position retaining teeth corresponding to the position of one sprocket in a second of the plurality of differing sprocket sets.

2. An apparatus according to Claim 1 wherein said control member is spring biased for rotation in a first direction; and further comprising:

    a release pawl mounted in said shifting mechanism, said release pawl being biased into engagement with said control member, said release pawl having a first and a second jaw, said first jaw configured to engage said large and small position retaining teeth preventing rotation of said control member in said first direction;

    an upshifting lever connected to said shifting mechanism, wherein said shifting mechanism is configured to rotate said control member in a second direction opposite said first direction in response to movement of said upshifting lever; and

    a downshifting lever configured to move said first jaw or said release pawl away from engagement with said control member and simultaneously move said second jaw toward said control member for engagement only with said large position retaining teeth thus allowing said control member to rotate in said first direction in accordance with position of said large position retaining teeth with respect to said second jaw.

3. A bicycle transmission shifting apparatus comprising:

    a fixed member;
    a takeup element rotatably supported on the fixed member for alternately rotating in a transmission element winding direction and in a transmission element unwinding direction, and takeup element being biased in the transmission element unwinding direction;

    a first control member for engaging the takeup element in the transmission element winding direction;

    a positioning retaining unit coupled to the takeup element and being switchable between a position retaining state for retaining the takeup element in a selected position and a position releasing state for allowing the takeup element to rotate in the transmission element unwinding direction, the position retaining unit including only a single position retaining pawl coupled to the takeup element; and

    a second control member for engaging the position retaining unit for switching the position retaining unit between the position retaining state and the position releasing state; wherein said position retaining unit further comprises a control wheel mounted for selective rotational movement within said position retaining unit, said control wheel being formed with a plurality large position retaining teeth and a plurality of small position retaining teeth, at least one of said small position retaining teeth formed between adjacent ones of said large position retaining teeth, each of said large position retaining teeth being positioned on said control wheel to correspond to the positions of the sprockets in a first of the plurality of differing sprocket sets, and at least one of said small position retaining teeth corresponding to the positions of the sprockets in a second of the plurality of differing sprocket sets.

FIG. 1

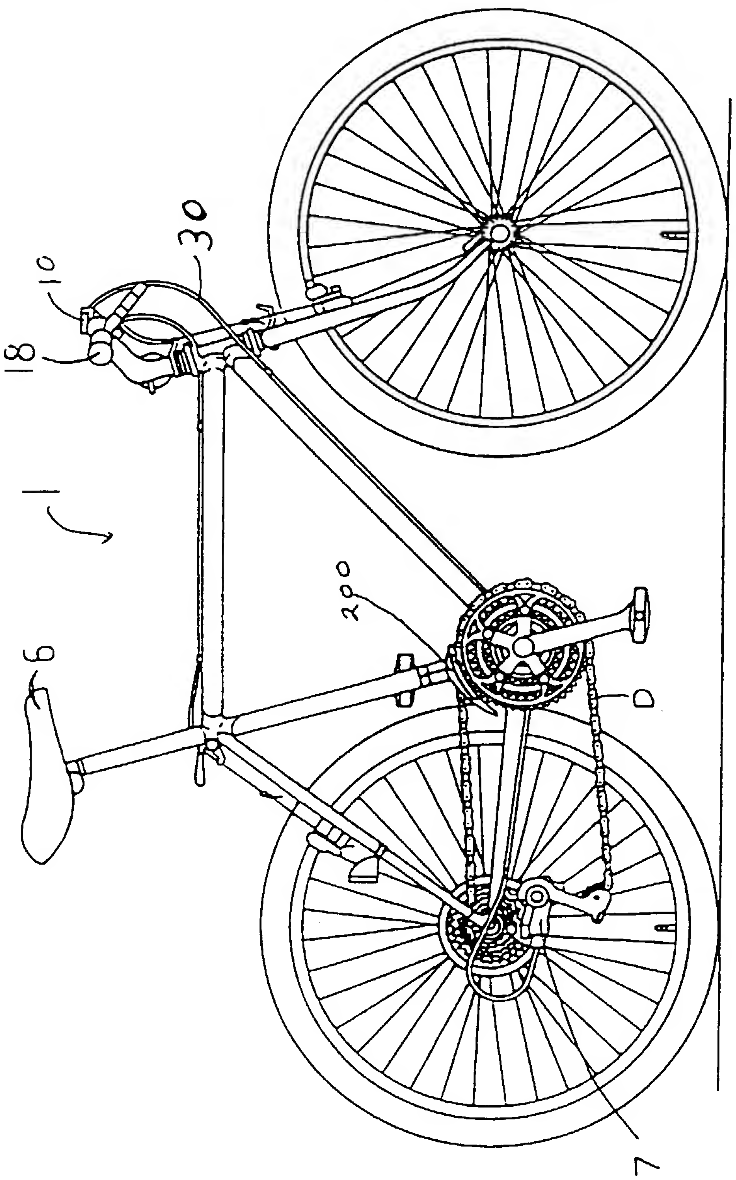


FIG. 2

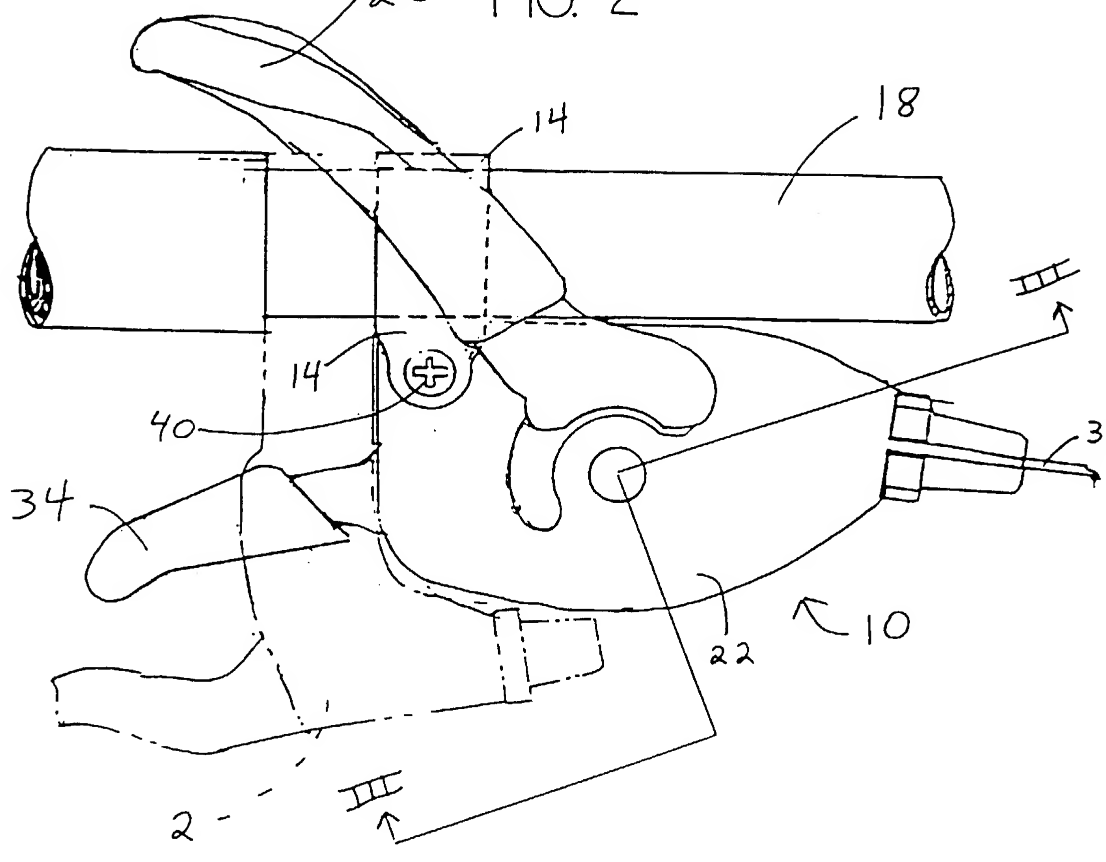
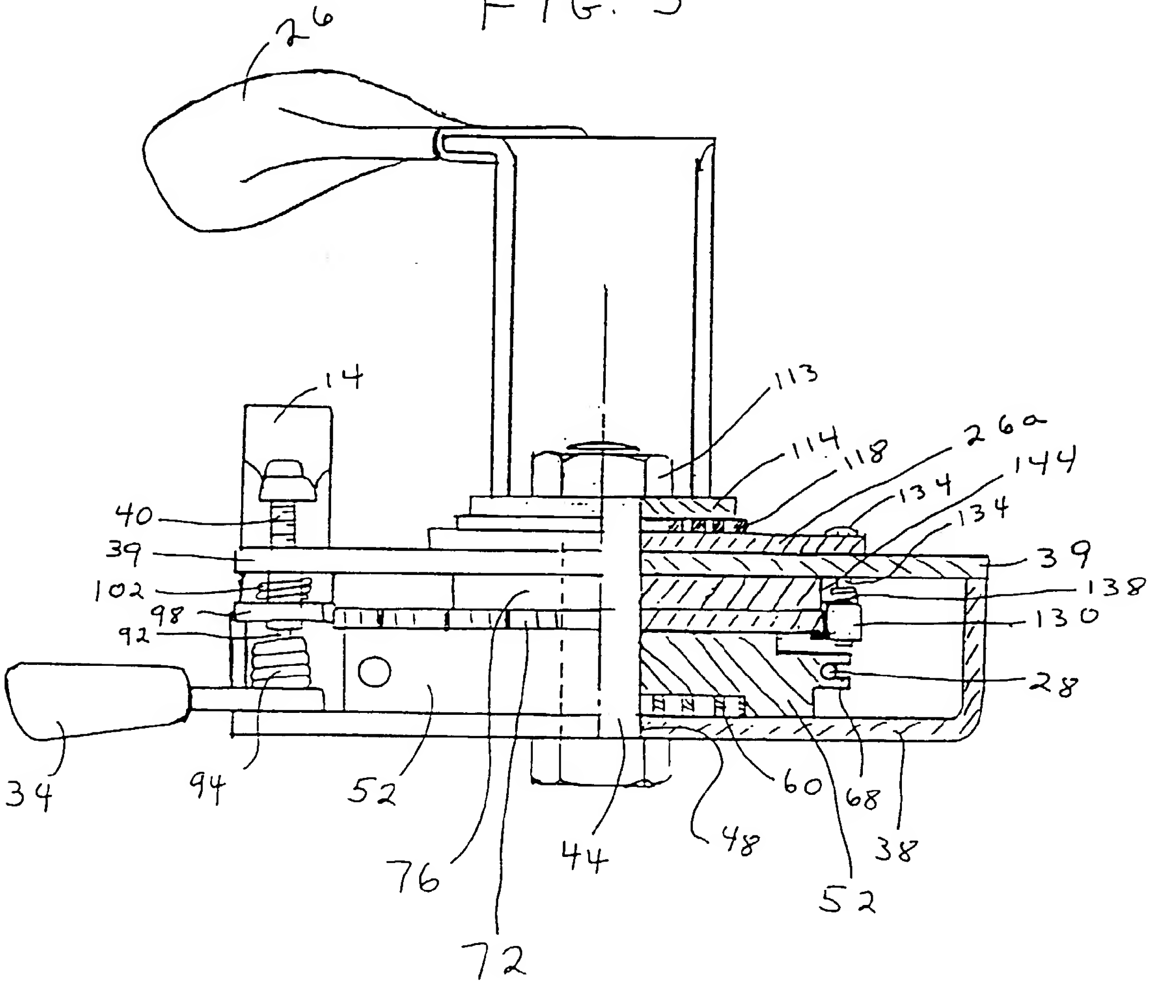


FIG. 3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114
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26a
144
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134
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76
44
48
52
72

FIG. 4A

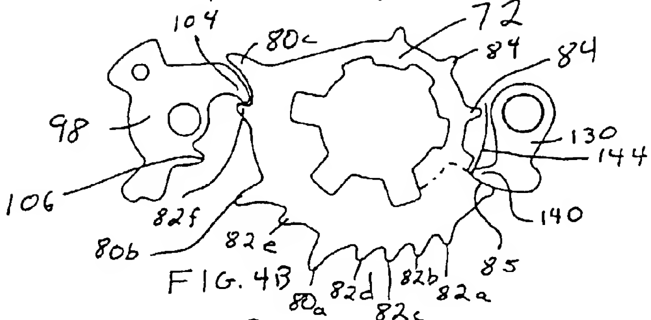


FIG. 4B

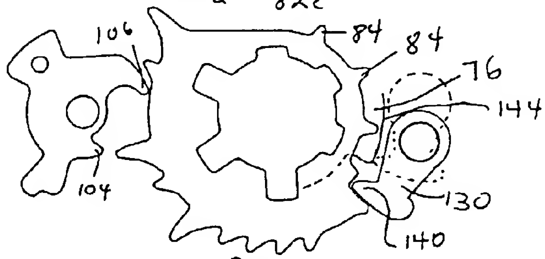


FIG. 4C

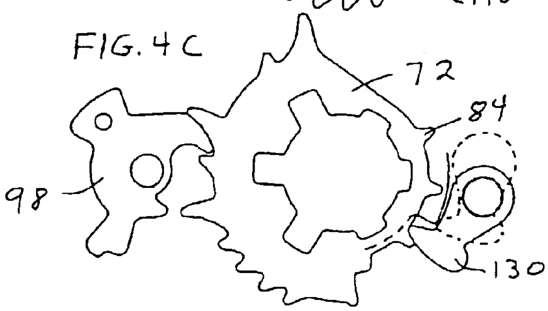


FIG. 4D

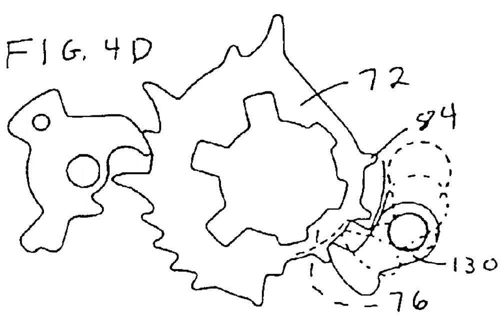


FIG. 4E

FIG. 4F

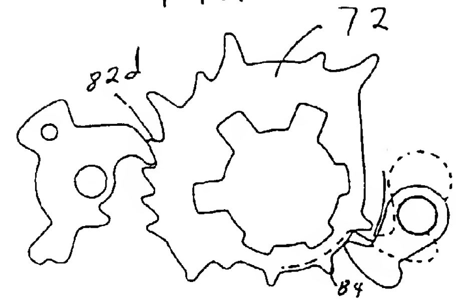


FIG. 4G

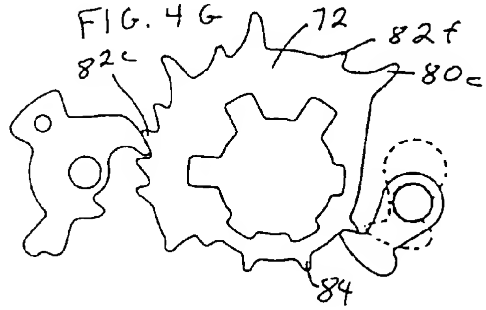


FIG. 4H

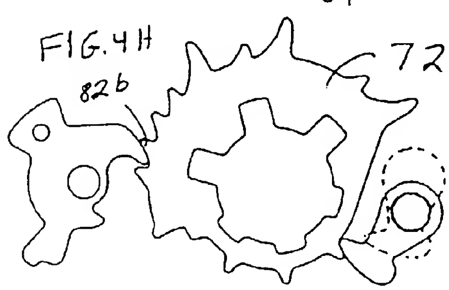
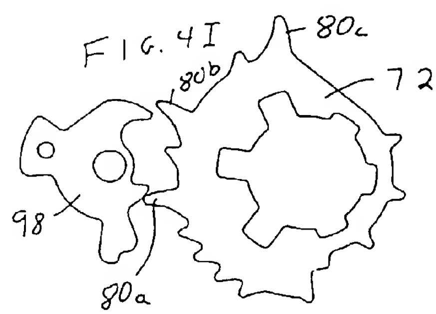


FIG. 4I



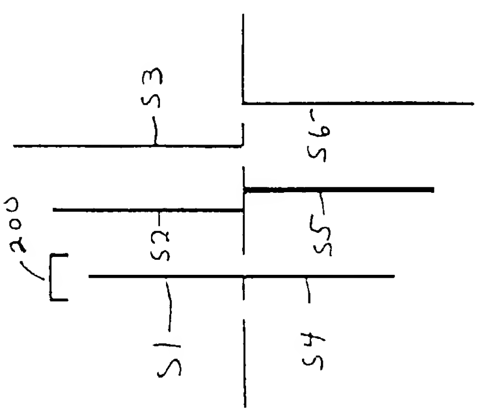


FIG. 5A

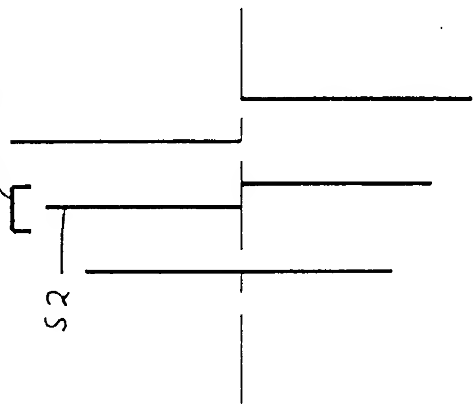


FIG. 5B

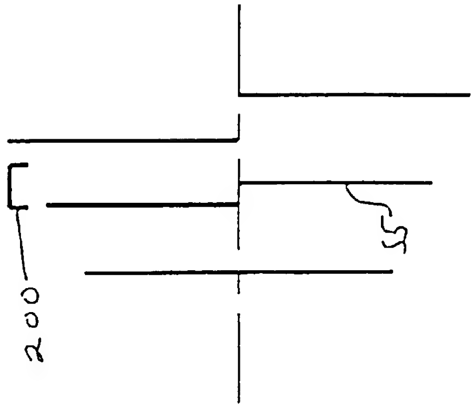


FIG. 5C

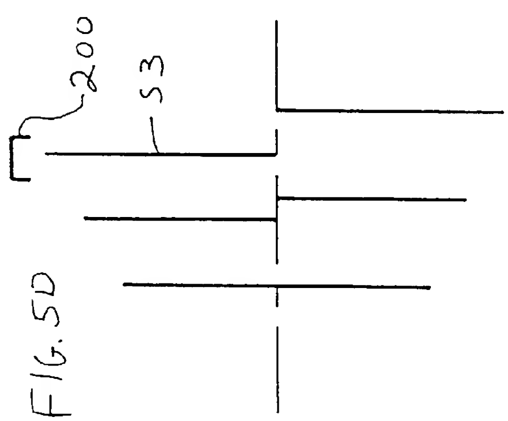


FIG. 5D

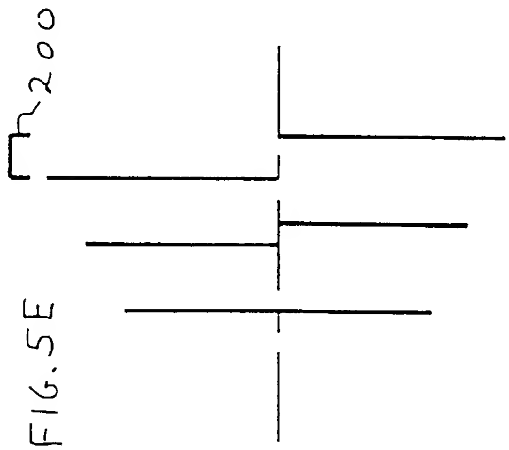


FIG. 5E

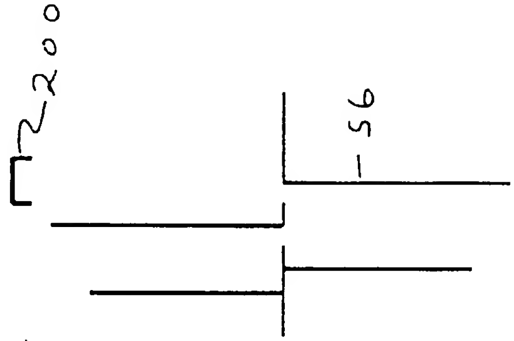


FIG. 5F

FIG. 6 PRIOR ART

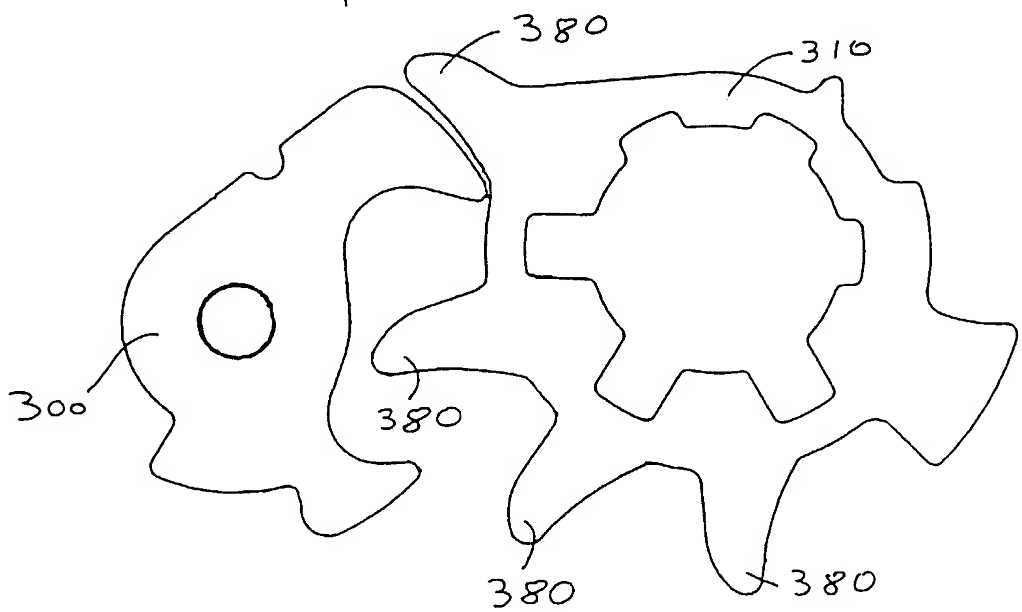


FIG. 7